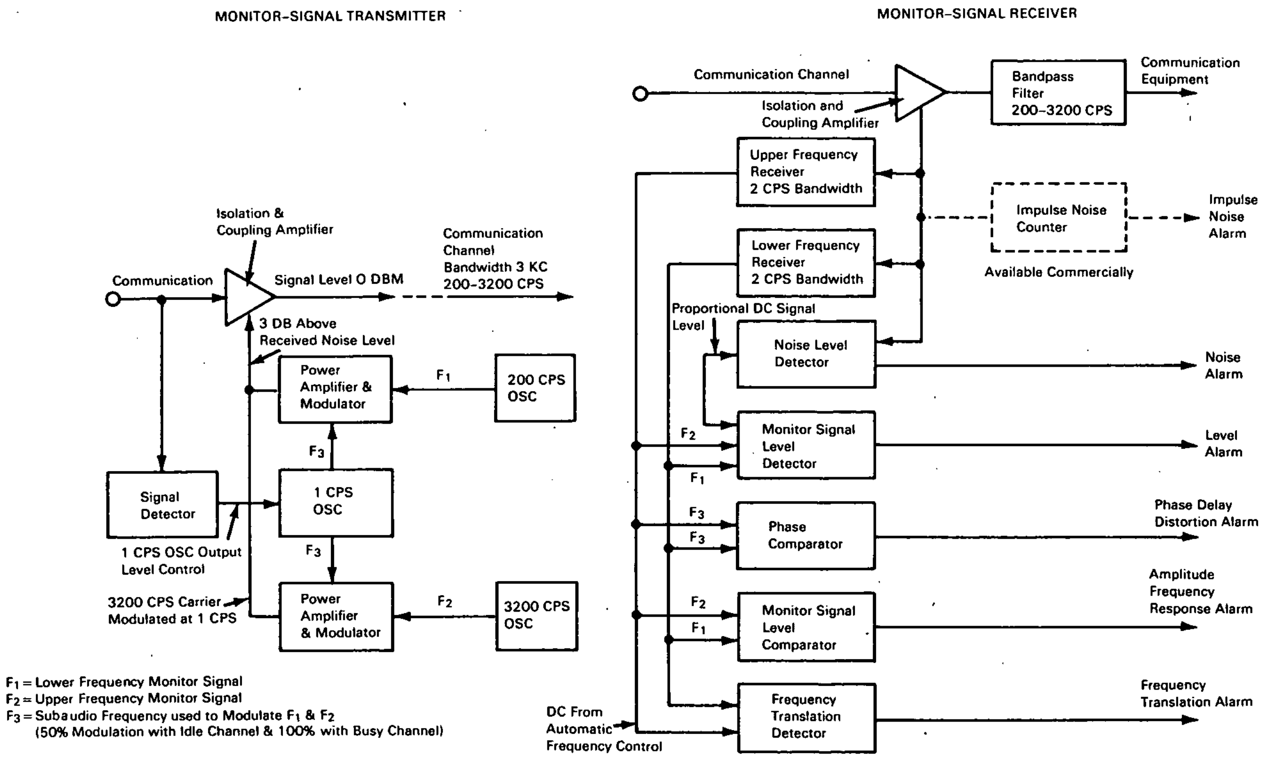
NASA TECH BRIEF

Monitor Assures Availability and Quality of Communication Channels



The problem:

To devise a monitoring system that continuously monitors a communication channel for proper circuit parameters and energizes an alarm if these parameters do not fall within allowable limits. The system must assure the availability and quality of a communication channel, whether in use or idle. It must determine when an idle channel has been interrupted or has deteriorated below usable standards, and it must monitor channel quality during circuit use. Although quality monitoring devices are commercially available and in general use for telegraph and low speed digital circuits, they cannot monitor channels carrying voice or other signals that contain many random frequencies. Also, they cannot monitor all the critical parameters of voice and high speed data circuits.

The solution:

A monitor system that comprises a monitor-signal transmitter at the transmitting end of the channel and a monitor-signal receiver at the receiving end;

(continued overleaf)

the monitor-signal transmitter generates two amplitude-modulated signals that are within the communications channel frequency band, one at the low frequency end and the other at the high-frequency end. The monitor-signal receiver detects the transmitted monitor signal and measures its power level, phase delay, frequency amplitude response, and degree of modulation. An alarm sounds if any of these measurements do not fall within normal limits.

How it's done:

Transmitter oscillators generate the upper and lower frequencies, F_1 and F_2, which are used to monitor channel quality. The 200- and 3200-cps oscillators are typical frequencies only. F_1 and F_2 are amplitude modulated by F_3, the output of the subaudio frequency oscillator. A communication signal detector controls the modulating output of this oscillator. During transmissions, the detector increases the output (F_3) of the oscillator. This increased output is detected at the receiver, thereby establishing that the communication channel is in use.

The power amplifiers and modulators isolate the oscillators from outside influence and permit amplitude modulation without frequency modulation. The isolation and coupling amplifier isolates the amplitude modulated monitor signals from the communications equipment and couples the monitor signal to the communications channel. It also provides for manual adjustment of the transmitted monitor-signal level.

At the monitor-signal receiver, the two monitor signals are separated and demodulated by the upper frequency and lower frequency receivers. The demodulated outputs of each receiver (F_1 and F_3; F_2 and F_3) are fed to the monitor-signal detectors and comparators.

The monitor-signal level detector adds the average power level of the upper and lower monitor frequencies (F_1 and F_2) to indicate communications channel signal level and also channel failure (zero-level condition). It also detects when the channel is in use by measuring the power level of the subaudio frequency modulation (50%, idle; 100%, in use). When this increase in modulation is detected, the level detector feeds a dc signal to the noise level detector, indicating the channel is in use.

The noise detector actuates its alarm at levels slightly greater than normal idle circuit noise. When the communication channel is in use, the dc signal from the monitor-signal level detector reduces the gain of the noise detector to prevent the communication signal from actuating the alarm.

The phase comparator compares the phase angle between the subaudio frequency outputs (F_3) of the upper and lower frequency receivers. These outputs are the same frequency, but one has been transmitted by the communication channel as a frequency below the signal band and the other as a frequency above it. Since these upper and lower frequencies started with their modulation in phase, from the same subaudio frequency oscillator, any phase difference at the receiver is a measure of the phase-delay distortion of the commercial channel.

The monitor-signal level comparator compares the received power level of the upper- and lower-frequency monitor signals (F_1 and F_2) and thus measures frequency distortion.

The frequency translation detector operates from the AFC error signal generated in the upper- and lower-frequency receivers. An alarm is sounded when this error signal exceeds a predetermined amount.

The bandpass filter removes the monitor-signal frequencies from the communication channel to prevent their interfering with channel use. This filter will not be necessary if the level of the monitor signal can be low enough that it is comparable to the normal channel noise.

Notes:

1. The channel quality monitor can be used in voice and high-speed data channels to assure circuit quality and channel availability. It is especially useful in high priority voice channels which do not carry traffic most of the time, but which must be operational and available immediately. In data circuits, it could signal substandard channel conditions that would ordinarily result in list time and data.
2. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Kennedy Space Center
   Kennedy Space Center, Florida 32899
   Reference: B67-10028

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: George P. Smith
of the RCA Service Company
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